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ABSTRACT

This study was designed to determine if the final grade in college biology at a suburban community college was a true measure of student's knowledge. One hundred and seventy undergraduates taking a semester course in biology took part in the study. This population was randomly separated into a control, placebo, and experimental group. The progress of the groups was tracked for 15 weeks. During this time the control group followed a traditional biology scheme of two lectures, one lab and one seminar each week. The placebo group also followed this schedule, but, in addition, was given a 20 to 30 minute presentation on the historical significance of the week's lab. A similar scheme was followed by the experimental group. However, rather than learning about the historical value of the lab, this group was given a specific 20 to 30 minute interaction that had previously been found to enhance a students visuo-spatial potential. At the end of the semester all the students were given written final exams and lab practicals (an exam that measures the student's skill and understanding of the semester's lab investigations). Statistical differences were noted between the experimental population and the other biology groups on the lab practical. (Author/TW)

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IS THE FINAL GRADE IN COLLEGE BIOLOGY A TRUE MEASURE OF STUDENT KNOWLEDGE?

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Is The Final Grade in College Biology a True Measure of Student Knowledge?

Abstract

The final grade awarded to a student at the end of a semester is, sometimes, not a true reflection of the person's overall knowledge of the course material. For many, success or failure in a class is determined by how well one does on one or two exams taken during the semester. Disappointingly, many courses do not include intuitive and creative thinking or skill achievement in the evaluation of the student's final grade.

A study was designed to find if the final grade in college biology at a suburban community college was a true measure of student's knowledge. One hundred and seventy undergraduates taking the semester course in biology took part in the study. This population was randomly separated into a control, placebo, and experimental group. The past academic histories of all the participants were checked and no statistical difference in scholastic knowledge was found for any group.

The progress of the groups was tracked for fifteen weeks. During this time the control group followed a traditional biology scheme of two lectures, one lab and one seminar each week. The placebo group also followed this schedule, but, in addition, was given a 20 to 30 minute presentation on the historical significance of the week's lab. A similar scheme was followed by the experimental group. However, rather than learning about the historical value of the lab, this group was given a specific 20 to 30 minute interaction that had previously been found to enhance a students visuo-spatial potentials and, therefore, their ability to see things more holistically.

At the end of the semester all the students were given written final exams and lab practicals (an exam that measures the student's skill and understanding of the semester's lab investigations). When an analysis of variance was run on the scores of the final written exam no significant differences were found. However, statistical differences were noted between the experimental population and the other biology groups on the lab practical. This suggests, therefore, that, in the dexteral and implicational aspects of biological knowledge, the experimental group understood the material on a higher plateau than the students in the non-experimental populations.

When, however, the final grades for the students in the general biology course were statistically examined, no differences between the placebo, control, and experimental groups could be found. This implies that all the groups were equal in their understanding of the course content, a premise that the analysis has shown to be false.

Is The Final Grade in College Biology a True Measure of Student Knowledge?

Students today seem more interested in grades than they are in knowledge. It's not uncommon for a class member to ask what must be done for an "A" or if he/she can do an "extra credit" report for the few additional points needed to reach 90 percent. So important are grades that often students devise elaborate and sophisticated cheating schemes. Seemingly, the grade has become the objective of the course, not the content. A student recently told me "it really doesn't matter to me how the professor teaches us, or even what he teaches us, as long as what he gives us at the end of the course is in the upper percentiles.

The blame, however, does not rest solely with the undergraduate. The parents of the students are also most eager to learn the courses' outcome. I have had my students' mothers or fathers call me on the phone regarding the grade earned by their offspring. Like their sons or daughters, the parents seem more concerned about the evaluation of their child's education than they are about the quality. When I ask them about this they say that the future employment or postgraduate potential for their child hinges on the student's GPA.

What is even more disturbing is that the final grade in many classes is sometimes not an honest reflection of a student's knowledge of the subject. On many college campuses, success or failure in a course is determined by how well a student did on one or two tests taken during the semester. Some classes may require an additional term paper or include attendance in the evaluative scheme but very few professors attempt to measure insightful, intuitive , creative thinking and skill achievement in their course.

The life sciences are as much a part of the problem as the other disciplines. Reid (1980) found that although over half the time each week was spent in the biology laboratory, the bulk of the grades for the course were based on classroom presentations. The practical, hands on, manipulative skills learned in the lab were rarely tested. Contemporary classrooms are sometimes so stuck in the traditional verbal-analytical approach to learning that the ramification of the subject matter is of little concern. This problem has recently become recognized and many educators are calling for a revamping of contemporary educational curricula (Anderson, 1976; Lord, 1984).

This study was designed to find if the final grades in college biology at a suburban community college were a true measure of student knowledge. One hundred and seventy undergraduates taking the second semester course in biology took part in the study. This population was randomly separated into a control, placebo, and experimental group. The past academic histories of all the participants were checked and no statistical difference in scholastic knowledge was found for any group. Perusal of past knowledge in science produced similar results.

The progress of the groups was tracked for fifteen weeks. During this time the control group followed a traditional biology scheme of two lectures, one lab and one seminar each week just as previous students taking biology had done for over a decade. The placebo group also followed this schedule, but, in addition, was given each week at the onset of their lab, a 20 to 30 minute presentation on the historical significance of the day's lab. A similar scheme was followed by the experimental group. However, rather than learning about the historical value of the

lab, this group was given a specific 20 to 30 minute interaction that had previously been found to enhance a students visuo-spatial potentials and therefore their ability to see things more holistically (Lord, 1985).

At the end of the semester all the students were given written final exams and lab practical final exams. Examples of each of these can be found in Figure 1. When an analysis of variance was run on the scores of the final written exam no significant differences were found (Table 1). The experimental population secured a mean percentage of 8.13 (B) on the written exam, while the placebo group averaged 81.7 (B). The control population's mean was also a B (80.9) on the written final exam.

However, statistical differences were noted between the experimental population and the other biology groups on the lab practical (Table 2). This test measured the student's complete understanding of the semester's laboratory investigations. For this exam, a number of stations were set up in the lab. These stations consisted of dissected specimens on lab trays, micro sections set up under magnifying scope, recordings and tracings from lab equipment utilized during the term, and various organs removed from preserved organisms. The students were expected to examine the representative specimen each station for a short time and answer a series of questions about it. Since many of these questions require manipulation, rotation, interpretation, disposition, and the symmetrical character of the object, it was an advantage to be adept in spatial-image formation. On this exam the experimental group scored a mean percentage of 89.7 (A-) while the placebo population recorded a mean of 83.2 (B) and the control

recorded a mean of 82.3 (B). The difference between the experimental population's average and the means of the other two biology groups was found to be significant at the .05 level (Table 3).

Therefore, in the implicational and holistic aspects of biological knowledge, the experimental group understood the material on a statistically higher plateau than the students in the non-experimental populations. When, however, the final grades for the students in the general biology course were examined, no differences between the placebo, control, and experimental groups could be found. Twenty-nine students received an A for the course, while fifty-one received a B. The experimental population contributed nine members to the A group and nineteen to the B group. This amount totaled 52% of the experimental group. However, the control population place 51% of its members in the A or B columns, while the placebo group contributed 48%. Five members of the experimental group attained a D average in College Biology II, while six placebo and four control subjects were awarded D's. The analysis of variance revealed a nonsignificant F value of 0.20 (Table 4). This suggests that none of the biology groups differed in their overall understanding of the course contents in College Biology II. This would indicate, therefore, that the final procedures for the college biology course are based more heavily on verbal and written aspects of biology than the practical application of the concepts.

Such a system suggests a serious flaw in the evaluative procedures in a contemporary biology course, The final course grade is generally understood as a measure of scholarship for a subject. This score indicates not only the level of understanding of subject terminology, but the level of conceptual knowledge as well. The measure also indicates the degree of sophistication achieved in laboratory dexterity and application.

In other words, the final grade is an all encompassing measure of student preparedness.

This expectation is rarely achieved in most college biology courses. The final grade is usually derived through a pencil and paper exam taken at the end of an academic semester. Due to time constraints placed on the instructor by the registrar for submission of final grades, the exam usually follows the objective format of short answer or multiple choice questions. When additional criteria are used to calculate the final average, it is generally weighed far below the written exam in importance.

The instructors of a biology course, for example, usually recognize the importance for a separate lab evaluation. Many insist that a weekly report of the lab be submitted, while others insist that a separate lab final be taken. The results of these measures, however, are barely considered equal in weight to the written test. The students, therefore, that excel in the lab but not on mastery of the objective test are punished by the present evaluation system.

As in most science disciplines, the study of biology has become very complex. To achieve mastery, today's biology students are not only expected to understand the theoretical and factual aspects of the subject, but also its implicational and practical ramifications. Iconic and spatial abilities can no longer take a back seat to serial-analytical thinking. Today both neural hemispheres share the responsibility for the conquest of the subject (Blakeslee, 1980; Lord, 1985). It is imperative that teachers in the life sciences recognize that positive achievement in the factual and hypothetical aspects of biology does not necessarily indicate mastery of the subject. Efforts must be made to incorporate practical and implicational knowledge into the evaluation process.

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TABLE 1

ANALYSIS OF VARIANCE FOR THE WRITTEN FINAL EXAM
FOR THE EXPERIMENTAL, PLACEBO AND CONTROL GROUPS

Practical	D	Sum SQ	Mean SQ	F Value
Between Groups	2	0.06	0.03	0.03
Within Groups	159	124.54	1.02	
Total	161	124.60		

TABLE 2

ANALYSIS OF VARIANCE FOR THE PRACTICAL FINAL EXAM
FOR THE EXPERIMENTAL, PLACEBO, AND CONTROL GROUPS

Practical	D	Sum SQ	Mean SQ	F Value
Between Groups	2	9.29	3.05	2.98 *
Within Groups	159	101.14	1.01	
Total	161	110.43		

* Indicates Significance of .05.

TABLE 3

SCHEFFE CONTRAST FOR THE PRACTICAL & WRITTEN FINAL FOR EACH GROUP

	N	Mean	SD	SE	Differences Between
Practical					
Experimental	54	1.46	0.78	0.01 >	Placebo & Control*
Placebo	54	2.04	0.96	0.14 <	Experimental*
Control	53	1.95	0.97	0.15 <	Experimental*
Written Final					
Experimental	54	2.07	1.02	0.15 =	All other groups
Placebo	54	2.07	0.99	0.13 =	All other groups
Control	53	2.02	1.01	0.15 =	All other groups

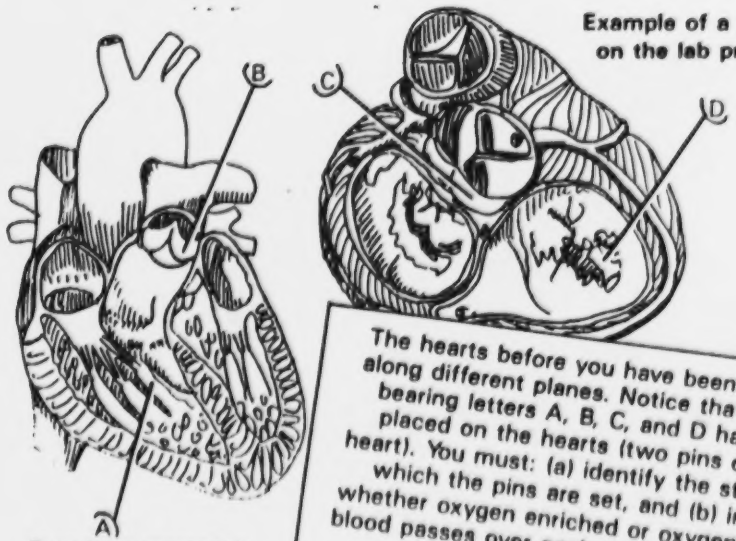
* Indicates significance of .05.

TABLE 4

ANALYSIS OF VARIANCE FOR THE FINAL GRADE FOR THE BIO GROUPS

	Of	Sum SQ	Mean SQ	F Value
Between Groups	2	0.39	0.19	0.20
Within Groups	159	118.59	0.97	
Total	161	118.99		

Example of a question on the lab practical



Drawings represent displayed organs on exam

The hearts before you have been sectioned along different planes. Notice that four pins bearing letters A, B, C, and D have been placed on the hearts (two pins on each heart). You must: (a) identify the structure in which the pins are set, and (b) indicate whether oxygen enriched or oxygen deficient blood passes over each structure in a healthy heart.

Example of a question on the written test

The graph **best** represents:

(a) the rate of transpiration in a herbaceous plant over a 24-hr. period

(b) the activity of a leaf's stomata over a 24-hr. period

(c) the quantity of glucose produced by a leaf in a 24-hr. period

(d) the rate of O_2 production by a leaf in a 24-hr. period

FIGURE 1
Sample Questions in the College Biology Final Exams